FRBSF WEEKLY LETTER

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Optimal Inflation

Rates of inflation have varied widely across countries and over time. Although economists generally agree that sustained inflation is caused by excessive money growth, this diversity in inflation experiences has led many to wonder what factors induce a country's monetary authority to allow excessive money creation in the first place. As we discussed in an earlier *Letter* (July 21, 1989), one line of research has focused on ways in which large fiscal deficits could force the monetary authority to print more money and thereby generate inflation. Another, more recent line of research suggests that prevailing rates of inflation, as well as prevailing tax rates and fiscal deficits (or surpluses), taken together, may be the government's optimal response to the need to balance its budget over time. In this *Letter,* we survey the work that has been done on the "optimal inflation" issue, and discuss some relevant empirical evidence.

What is "optimal?"

Economists use the term "optimal inflation" to describe the inflation rate that minimizes distortions that might prevent an economy's scarce resources from being used efficiently. Distortions will arise when the private cost of consuming a good and the social cost of producing it are not equal. In this case, the "optimal" amount of that good will not be produced and consumed. A private cost below the social cost will lead to too much of the good being produced, while a private cost above the social cost will lead to too little being produced.

To determine the optimal rate of inflation, Nobel-laureate Milton Friedman applied this notion of private and social costs to money. Money provides certain services of value to individuals, such as facilitating transactions. Since money does not earn interest, the cost of holding it essentially is the interest income on other assets that must be sacrificed. Because of this cost, individuals will attempt to economize on their money holdings. Yet the social cost of printing more money is essentially zero. As a result, too little money will be held, thereby introducing economic distortions associated with higher-than-optimal transactions costs.

In order to get around this problem, Friedman suggested that *deflation* actually would be optimal. Specifically, he suggested that the optimal rate of deflation would be the rate of return on nonmonetary assets. With prices falling at this rate, non-interest-bearing money would yield a rate of return, adjusted for price changes, equal to that on other assets, and the opportunity cost of holding non-interest-bearing money would be zero—the same as the social cost of producing money. Individuals then would be indifferent between money and other assets on a rate of return basis, and would therefore hold enough money to ensure that no distortions arise from insufficient liquidity in the economy.

Revenue constraint

Deflation, however, may not be optimal because the government faces a revenue constraint. The government must raise revenues, by raising taxes and/or by printing money. It is well known that the government can use the money it prints to purchase real goods and services, and in this sense, inflation can be a source of revenue. If, however, the monetary authority were to engineer a steady deflation by retiring money, it would have to transfer real resources to the private sector and obtain revenues to do so from other tax sources.

Unfortunately, obtaining increased revenues from other forms of taxation generally will cause distortions in economic activity, as individuals modify their behavior in order to avoid these new demands. Raising income tax rates, for example, reduces the amount of consumption goods that can be obtained for a given amount of labor, and causes individuals to alter their decisions regarding how much to work. In addition, the historical evidence suggests that as tax rates increase, society begins to divert increasing amounts of resources to tax avoidance. Since these resources are not being used for any intrinsically useful purposes, they are a net loss to society. These

losses are commonly referred to as the deadweight costs of taxation.

Thus, Friedman's rule eliminates distortions arising from holding an inappropriate amount of money only at the cost of imposing significant distortions on other kinds of economic decisions. Instead, the optimal rate of inflation is that which, together with the taxes the government imposes, generates sufficient revenues while minimizing distortions from both sources.

To minimize the distortionary costs of raising a fixed amount of revenue *at any point in time*, the government should equate marginal distortionary costs across all available revenue-raising instruments. This means that if the government had only two kinds of revenue sources available to it, say, an income tax and a wealth tax, and the marginal distortionary costs associated with the income tax exceeded those associated with the wealth tax, the government should lower the income tax rate and raise the wealth tax rate (to produce the same amount of total revenue) until the deadweight losses arising from the two kinds of taxes were equalized on the margin.

Economists Martin Bailey and Edmund Phelps applied this reasoning to the optimal inflation question. They showed that the optimal tax policy would involve raising revenues both from conventional fiscal taxes and from taxing money holdings through inflation.

Optimizing over time

Robert Barro extended this analysis to show that the same principles could be used to determine the evolution of tax rates over time, assuming—for simplicity—that inflation was not used to raise revenues. He reasoned that governments would be interested in minimizing the distortionary costs of taxation, not just at any point in time, but in the future, as well. Accordingly, they would set tax rates so that the marginal distortionary costs of raising revenues were equal across time periods. Once again, it is easy to see why this is an optimal policy. If the distortionary costs are unequal across different time periods, the government simply lowers taxes in the high distortion period and raises them in the low distortion period in such a way that it obtains the same revenue as before. The result of this process is a reduction in total distortionary costs with no change in the revenue obtained over time by the government.

Several interesting implications follow from this theory. If marginal distortionary costs are proportional to tax rates, the condition that the government equate marginal costs across time periods implies that planned tax rates be equal across time periods as well. Thus, if government expenditures are perfectly predictable, tax rates will be constant over time. Because tax rates are never expected to change, this theory is often called the "tax smoothing" hypothesis. Tax rates would change only because of unpredictable changes in government spending. Further, temporary but predictable changes in government spending would lead to variations in the fiscal deficit, not changes in tax rates. The government would run deficits during periods when spending is above its permanent levels, and surpluses when spending is below permanent levels.

Economist Gregory Mankiw combined Barro's analysis with that of Bailey and Phelps to note that if both fiscal and monetary policy are used optimally to finance a change in government expenditures, deadweight losses can be minimized by adjusting all revenue instruments a small amount, rather than by making a major adjustment in one instrument. Consequently, shocks to the government's revenue needs would require that both tax rates and inflation be adjusted in the same direction. The experience of the 1980s superficially seems consistent with this hypothesis; tax cuts in the early 1980s were accompanied by a major reduction in the level of inflation.

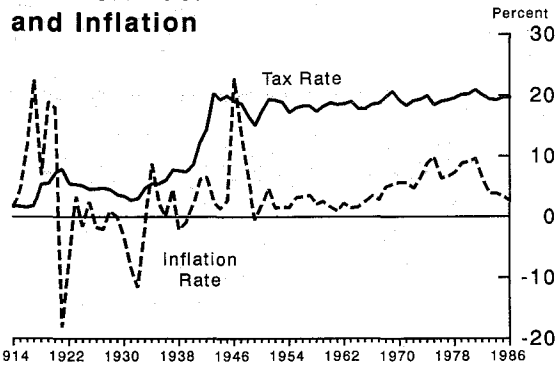
However, tax rates can be adjusted for reasons other than changes in permanent expenditures. Changes in the economy's structure that affect the relative distortionary costs of alternative revenue sources will lead the government to adjust its tax mix. For example, an increase in the stock of money that the public is willing to hold would increase the tax base against which the inflation tax can be levied, and would increase the revenue obtained from a given increase in inflation. The optimal policy response then is to increase inflation and lower other taxes. In this case, inflation would move in the opposite direction from other tax rates. Consequently, in attempting to verify this hypothesis,

we must be careful to identify the kinds of disturbances that are the cause of changes in tax rates and inflation.

Empirical evidence

The chart shows the behavior of the tax rate and the rate of inflation since 1914, the year that the Federal Reserve was founded. We measure the tax rate as the ratio of government receipts to GNP and the inflation rate as the change in the GNP deflator. The chart reveals that while the inflation rate has tended to move up and down over time, changes in the tax rate have been more permanent in nature. These characteristics are especially noticeable in the period around the two World Wars. In both cases, the rate of inflation went up sharply, and then declined. In contrast, the tax rate has not declined significantly in the period following World War II.

U.S. Tax Rates and Inflation



The positive response of both tax rates and inflation to the need for greater revenue during wartime is consistent with the tax smoothing hypothesis. However, the hypothesis also predicts that both should have moved together after the wars, remaining at higher levels than before in order to pay off the debt acquired over this period. The behavior of tax rates and inflation in the postwar periods clearly contradicts the hypothesis.

Of course, the divergence of tax rates and inflation could have been due to changes in relative distortionary costs. Formal statistical tests that control for such a possibility can be used to test the tax smoothing hypothesis. One of the implications of the hypothesis is that permanent changes in the tax rate should be related to permanent changes in inflation. However, in our tests we find no evidence of such a relationship. While there is some evidence of a positive relationship between taxes and inflation in the postwar period, this relationship appears to be limited to short-run movements in the two series. Other researchers have looked at data for European countries and have not found any evidence that supports the tax and inflation smoothing hypothesis. Accordingly, it appears reasonable to conclude that the positive relationship between taxes and inflation observed over the postwar period in the U.S. is due to other factors. One such factor is the well-known "bracket creep" phenomenon: since tax rates were not indexed to inflation over this period, rising inflation was accompanied by higher taxes.

Better understanding needed

The tax smoothing hypothesis is appealing because it is based on the presumption that prevailing levels of both tax rates and inflation are the optimal response of policymakers to the government's need for revenue in the presence of distortionary costs. In this sense, the approach attempts to find a fundamental explanation for inflation that avoids the temptation to resort to *ad hoc* factors such as oil price changes or food price fluctuations. Unfortunately, the hypothesis appears inconsistent with the U.S. and European experiences. Nonetheless, prevailing levels of inflation may still be the outcome of optimizing behavior on the part of policymakers; our evidence suggests that to explain inflation, we also need to understand why governments often resort to inflation to finance temporary bulges in expenditures.

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